(12) UK Patent Application (19) GB (11) 2 314 999 (13) A

(43) Date of A Publication 14.01.1998

(21) Application No 9713696.4

(22) Date of Filing 30.06.1997

(30) Priority Data
(31) 96026962 (32) 30.06.1996 (33) KR

(71) Applicant(s)
Samsung Electronics Co Limited

(Incorporated in the Republic of Korea)

416 Maetan-dong, Paldal-gu, Suwon-city, Kyungki-do, Republic of Korea

(72) Inventor(s)
Hyung Koh

(74) Agent and/or Address for Service
Dibb Lupton Alsop
Fountain Precinct, Balm Green, SHEFFIELD, S1 1RZ, United Kingdom

(51) INT CL[6]
H04B 1/707 7/26, H04L 27/18

(52) UK CL (Edition P)
H4P PDCSL

(56) Documents Cited
GB 2298342 A GB 2188517 A US 5506862 A
US 5467367 A US 5101406 A

(58) Field of Search
UK CL (Edition O) H4P PAPS PAQ PDCSL
INT CL[6] H04B 1/69 1/707 7/216 7/26, H04J 13/02 13/04, H04L 27/18
ONLINE : WPI

(54) Transceiver operating in time division full duplex spread spectrum communication

(57) A transceiver for direct conversion time division full duplex spread spectrum communication is described. It includes an antenna, 110 a time division duplexer 112 which couples the antenna to a transmission path or a receiving path of the transceiver in respective time intervals and a PLL 230 for generating an oscillation signal. The receiving path comprises a phase shifter 232 which phase shifts the oscillation signal by 90 degrees to provide a phase shifted oscillation signal. A first frequency mixer 226 generates a first base band signal by synthesising the oscillation frequency with a signal received from the time division duplexer 112 and a second frequency mixer 228 generates a second base band signal by synthesising the phase shifted oscillation frequency with the signal received from the time division duplexer 112. A demodulator 238 outputs pseudo noise data by decoding the first and second base band signals. The transmitting path includes a third frequency mixer 242 which provides to the time division duplexer 112 a modulated transmission signal by synthesising incoming pseudo noise data with the oscillation frequency or the phase shifted oscillation frequency.

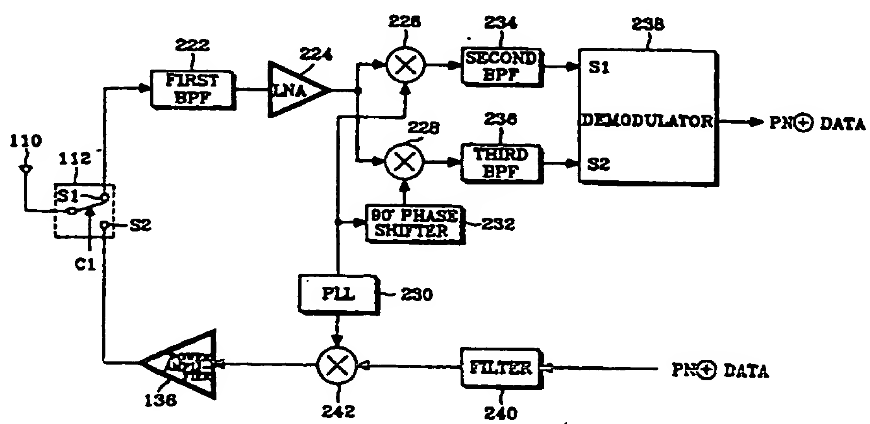

FIG. 2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

GB 2 314 999 A

TRANSCEIVER OPERATING IN TIME DIVISION FULL DUPLEX SPREAD SPECTRUM COMMUNICATION

BACKGROUND OF THE INVENTION

The present invention relates to a transceiver operating in direct conversion time division full duplex spread spectrum communication, e.g. according to digital wide band modulation of differential binary phase shift keying system.

Referring to Fig. 1, an antenna 100 receives signals and transmits modulated and amplified signals into the surroundings. A time division duplexer 112 switches between transmission mode and receiving mode in a given time interval. The transceiver is set in receiving mode when a switch of the duplexer is switched to a first terminal S1 and set in transmission mode when the switch is switched to a second terminal S2 by a control signal C1 from a controller (not shown) that controls the transceiver overall. A low noise amplifier LNA 114 amplifies a signal from the time division duplexer 112 to a given level. A first band pass filter BPF 116 passes only a signal within a given band in the amplified received signal.

A filter 124 converts a square wave signal to a sine wave signal by receiving and low pass filtering pseudo noise PN + data. A first phase-locked loop PLL produces a finely variable frequency by frequency synthesizing using a stabilised oscillator. The first PLL oscillates at a high frequency modulated by the PN + data sine wave signal from the filter 124. A first frequency mixer 118 produces a first intermediate frequency signal by attenuating the signal transmitted from the first BPF 116 by an oscillation frequency from the first PLL 120. The second BPF 122 passes only the first intermediate frequency. A signal identical to the control signal C1 of the time division duplexer 112 is received and causes switching to the first switch terminal S1 in receiving mode and to the second switch terminal S2 in transmission mode by the first PLL.

A second PLL 130 produces first and second oscillation frequency VS1 and VS2 according to an external control voltage CV. The second PLL 130 transmits the first oscillation frequency VS1 in receiving mode and the second oscillation frequency VS2 in transmission mode according to a signal identical to the control signal C1.

A demodulator 126 converts the first intermediate frequency passed from the second BPF 122 to the second intermediate frequency by synthesizing with the VS1, amplifies it and demodulates it to the PN + data. A second frequency mixer 132 produces a transmission signal by synthesizing the second oscillation VS2 from the second PLL 130 and the oscillation frequency from the fist PLL 120. A third BPF 134 transmits only a transmission signal within a desired band after receiving the transmission signal from the second frequency mixer 132. A power amplifier 136 amplifies the transmission signal passed from the BPF 134 to a desired power.

The time division duplexer 112 transmits a receipt signal from the antenna 110 when switched to the first terminal S1 in receiving mode by the control signal C1. The receipt signal is amplified by the LNA 114, filtered by the first BPF 116 and transmitted to the first frequency mixer 118. The receipt signal is converted to the first intermediate frequency by the first PLL, filtered by the second BPF 122 and converted to the second intermediate frequency by the demodulator 126 and becomes the modulated PN + data.

The second frequency mixer 132 produces a transmission signal by synthesizing the VS2 from the second PLL 130 and the oscillation frequency from the first PLL 120. And the transmission signal is filtered by the third BPF 134 and amplified by the power amplifier 136. The time division duplexer 112 is now switched to the second switch terminal S2 and the amplified transmission signal is transmitted through the antenna 110 into the surroundings.

Accordingly, time division duplex noise is produced according to the on/off operations of the second PLL 130 in the conventional transceiver. Unwanted frequencies occur due to spurious and harmonic ingredients produced in the two oscillation circuits and the complexity the circuit of the demodulator 126 which uses first PLL 120 and second PLL 130.

It is an object of the present invention to provide a transceiver for direct conversion time division full duplex spread spectrum communication which eliminates such noise.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a transceiver for direct conversion time division full duplex spread spectrum communication comprising an antenna, a time division duplexer for coupling the antenna to a transmission path or a receiving path of the transceiver in respective time intervals and an oscillator for generating an oscillation signal, in which:

the receiving path comprises a phase shifter for phase shifting the oscillation signal to provide a phase shifted oscillation signal, a first frequency mixer for generating a first base band signal by synthesising the oscillation frequency with a signal received from the time division duplexer, a second frequency mixer for generating a second base band signal by synthesising the phase shifted oscillation frequency with the signal received from the time division duplexer and a demodulator for outputting pseudo noise data by decoding the first and second base band signals; and

the transmitting path comprises a third frequency mixer for providing to the time division duplexer a modulated transmission signal by synthesising incoming pseudo noise data with the oscillation frequency or the phase shifted oscillation frequency.

Preferably, the transmitting path further comprises a low pass filter for converting a square wave incoming pseudo

noise data signal to a sine wave pseudo noise data signal which is supplied to the third frequency mixer and an amplifier between the third frequency mixer and time division duplexer.

Preferably, the receiving path further comprises a first band-pass filter between the time division duplexer and the first and second frequency mixers, an amplifier between the first band-pass filter and the first and second frequency mixers and second and third band-pass filters between the first and second frequency mixers and the demodulator.

Preferably, the phase shifter is a 90 degree phase shifter and the demodulator is an orthogonal demodulator.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described by way of example with reference to the accompanying drawings in which:

Fig. 1 is a block diagram illustrating a conventional transceiver; and

Fig. 2 is a block diagram illustrating a transceiver according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to Fig. 2, an antenna 10 receives a tuned signal and transmits a modified and amplified signal into the surroundings. A time division duplexer 112 switches from transmission mode to receiving mode in a given time interval, and vice versa. The transceiver is set to receiving mode or transmission mode according to a switch terminal being switched to a first terminal S1 or a second terminal S2 respectively. A first BPF 222 passes only a signal of a given band received from the time division duplexer 112. An LNA 224 amplifies a receipt signal from the first BPF 222 by a given level. A PLL 230 using a frequency mixer generates a fine oscillation frequency by synthesizing a frequency by using a stabilised crystal oscillator.

A first frequency mixer 226 generates an in-phase first base band signal S1. A 90 degree phase 232 generates a 90 degree phase shifted frequency by receiving and processing the oscillation frequency. A second frequency mixer 228 generates a second base band signal S2 demodulated orthogonally by synthesising an output from the 90 degree phase shifter 232 and a high frequency from the LNA 224. A second BPF 234 is made to pass only the first base band signal S1 from the first frequency mixer 226, and a third BPF 236 is made to pass only the second base band signal S2 from the second frequency mixer 228. A demodulator 238 generates PN + data by demodulating the first and second base band signals S1 and S2. A filter 240 converts an incoming square wave signal of PN + data to a sine wave signal.

A third frequency mixer 242 performs a modulation operation by synthesising the sine wave signal and the oscillation frequency from the PLL 230. A power amplifier 136 amplifies a transmission signal modulated by the third frequency mixer 242 and transmits it to the time division duplexer 112. At this time, the amplified transmission signal is transmitted through the antenna 110 in the air by the terminal of the time division duplexer 112 being switched to the second terminal S2.

The operation of the circuit will now be described with reference to Fig. 2. The control signal C1 switches the switching terminal of the time division duplexer 112 to the first terminal S1 to receive a signal from the antenna 110 in the receiving mode. The received signal is filtered through the first BPF 22 and amplified by the LNA 224. The amplified signal is mixed with the oscillation frequency generated by the PLL 230 by the first frequency mixer 226, converted into the first base band signal S1. The amplified signal is also mixed with the output signal of the 90° phase shifter 232 by the second frequency mixer 228 demodulated into the second base band signal S2. The first and second base band signal S1 and S2 are filtered

respectively through the second and third BPF 234 and 236 applied to the demodulator 238, which demodulates the first and second base band signal S1 and S2 to generate the PN + data.

In the transmission mode, the filter 240 receives the PN + data to generate a sine wave signal, which is mixed with the oscillation signal by the third frequency mixer generating a signal to transmit. The signal is amplified by the power amplifier 136. Then, the time division duplexer 112 switches the amplified signal to the second terminal S2 to transmit the amplified signal through the antenna 110 to the surroundings.

Thus, the oscillation PLL 230 is kept turned on compared with the conventional system, preventing TDD noise. Moreover, a single oscillation circuit is used, simplifying the circuit, so that the spurious and harmonic noises are considerably reduced, resulting in a simple circuit for preventing such noises. In addition, the treatment of the demodulator is simplified.

CLAIMS

1. A transceiver for direct conversion time division full duplex spread spectrum communication comprising an antenna, a time division duplexer for coupling the antenna to a transmission path or a receiving path of the transceiver in respective time intervals and an oscillator for generating an oscillation signal, in which:

the receiving path comprises a phase shifter for phase shifting the oscillation signal to provide a phase shifted oscillation signal, a first frequency mixer for generating a first base band signal by synthesising the oscillation frequency with a signal received from the time division duplexer, a second frequency mixer for generating a second base band signal by synthesising the phase shifted oscillation frequency with the signal received from the time division duplexer and a demodulator for outputting pseudo noise data by decoding the first and second base band signals; and

the transmitting path comprises a third frequency mixer for providing to the time division duplexer a modulated transmission signal by synthesising incoming pseudo noise data with the oscillation frequency or the phase shifted oscillation frequency.

2. A transceiver according to claim 1 in which the transmitting path further comprises a low pass filter for converting a square wave incoming pseudo noise data signal to a sine wave pseudo noise data signal which is supplied to the third frequency mixer.

3. A transceiver according to claim 1 or claim 2 in which the transmitting path further comprises an amplifier between the third frequency mixer and time division duplexer.

4. A transceiver according to any preceding claim in which the receiving path further comprising a first band-

pass filter between the time division duplexer and the first and second frequency mixers.

5. A transceiver according to claim 4 in which the receiving path further comprising an amplifier between the first band-pass filter and the first and second frequency mixers.

6. A transceiver according to any preceding claim in which the receiving path further comprises second and third band-pass filters between the first and second frequency mixers and the demodulator.

7. A transceiver according to any preceding claim in which the phase shifter is a 90 degree phase shifter and the demodulator is an orthogonal demodulator.

8. A transceiver for direct conversion time division full duplex spread spectrum communication substantially as described with reference to and/or as illustrated in FIG. 2 of the accompanying drawings.

The Patent Office

9

Application No: GB 9713696.4
Claims searched: 1 to 8

Examiner: Ken Long
Date of search: 30 September 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4P (PDCSL, PAPS & PAQ)

Int Cl (Ed.6): H04B (1/69, 1/707, 7/216, 7/26)
H04L (27/18)
H04J (13/02 & 13/04)

Other: ONLINE : WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2298342 A	ROKE MANOR	None
A	GB 2188517 A	MULTITONE	None
A	US 5506862	DIGITAL WIRELESS	None
A	US 5467367	CANON	None
A	US 5101406	TELESYSTEMS	None

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

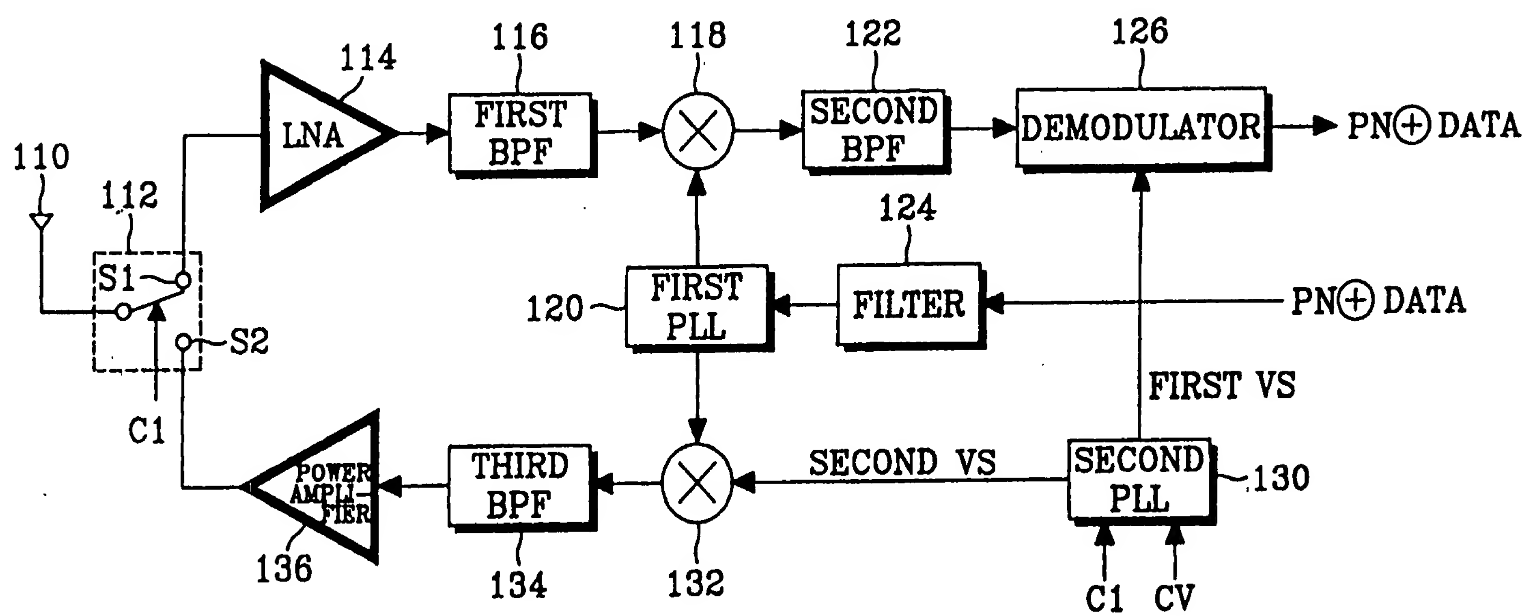
110
112
S1
S2
C1
114
LNA
116
FIRST BPF
118
122
SECOND BPF
126
DEMODULATOR
PN⊕DATA
124
FILTER
120
FIRST PLL
PN⊕DATA
FIRST VS
SECOND VS
SECOND PLL
130
C1
CV
132
THIRD BPF
134
POWER AMPLI-FIER
136

FIG. 1

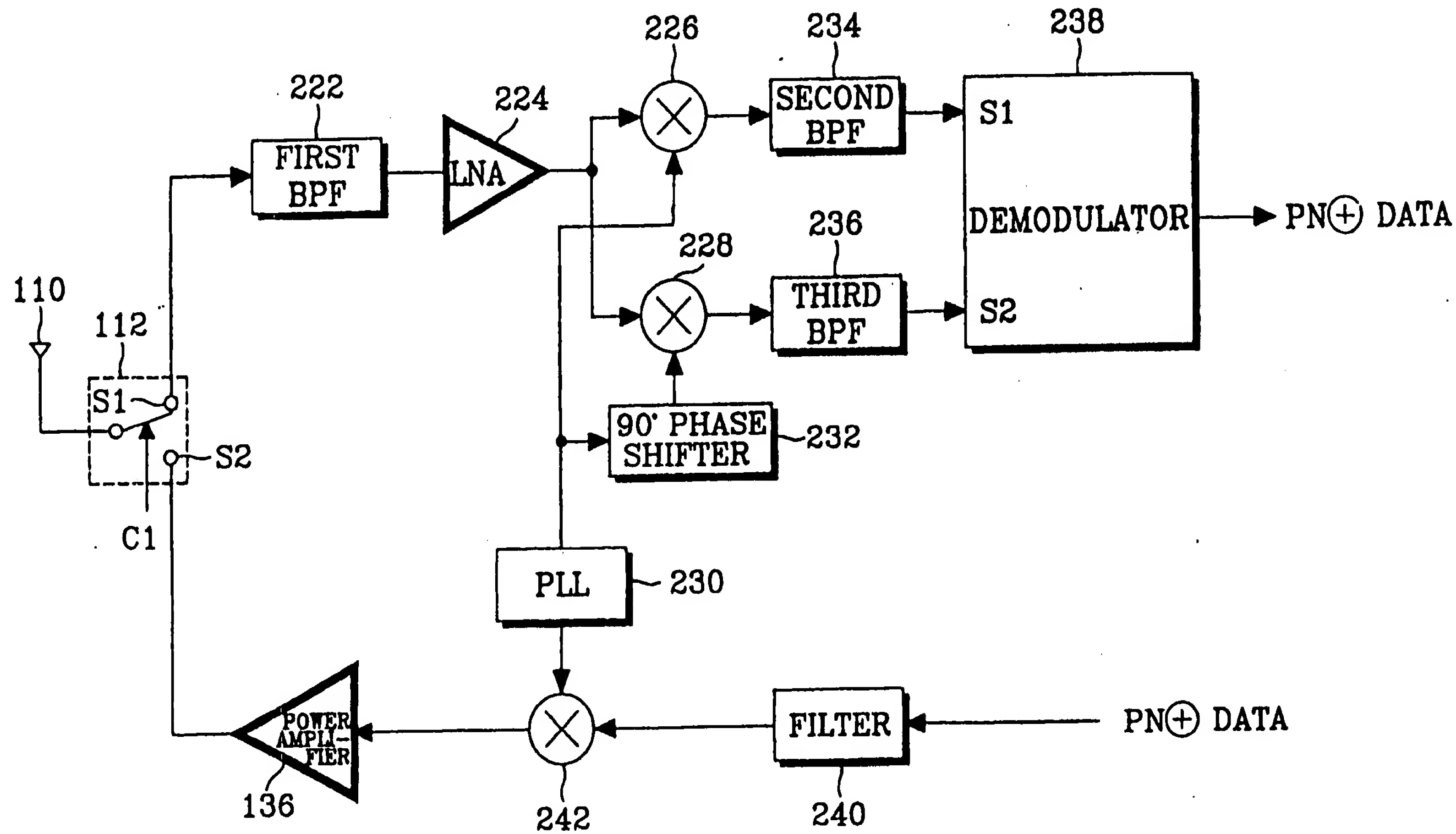
110
112
S1
S2
C1
222
FIRST BPF
224
LNA
226
228
230
PLL
232
90° PHASE SHIFTER
234
SECOND BPF
236
THIRD BPF
238
S1
DEMODULATOR
S2
PN⊕ DATA
240
FILTER
PN⊕ DATA
242
POWER AMPLI-FIER
136

FIG. 2